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Bioassay of pyrethroid insecticide esfenvalerate using fractal analysis of Daphnia Magna motion

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Abstract

The article presents the data on the impact of pyrethroid insecticide esfenvalerate assessment at the concentration of 3 mcg • l-1 (the Russian standard of this pesticide content in water) on the nature and complexity of Daphniamagna movement. The analysis is performed using the system "TrackTox", implementing computer vision algorithms. It is shown that in the presence of esfenvalerate (at 30 min exposure to toxicant) the swimming activity stimulating response is observed for Daphnia. The statistically significant increase in the swimming speed of Daphnia takes place from 0.58 cm • s-1 in control group to 0.98 cm • s-1 in experimental group. Also, the complexity of Daphnia movement is changed. The complexity of movement was evaluated through fractal analysis of daphnia swimming trajectories before and after the introduction of pesticide. Using the method of cell counting, it was stated that the trajectory of individual Daphnia has a fractal character, which may be described by the fractal dimension close to 1.4. It was found that the fractal dimension of Daphnia swimming trajectories is significantly increased from 1.39 in normal conditions to 1.46 in the presence of esfenvalerate. The presence of a pronounced Daphnia response to the presence of pesticides in water at a controlled norm suggests the possibility of this bioassay use for the detection of low concentrations of pesticides, as for the rapid assessment of aquatic toxicity in environmental monitoring, so as for the construction of early warning biological systems.

Keywords

Bioassay, Computer vision, Daphnia magna, Esfenvalerate, Fractal analysis, Fractal dimension